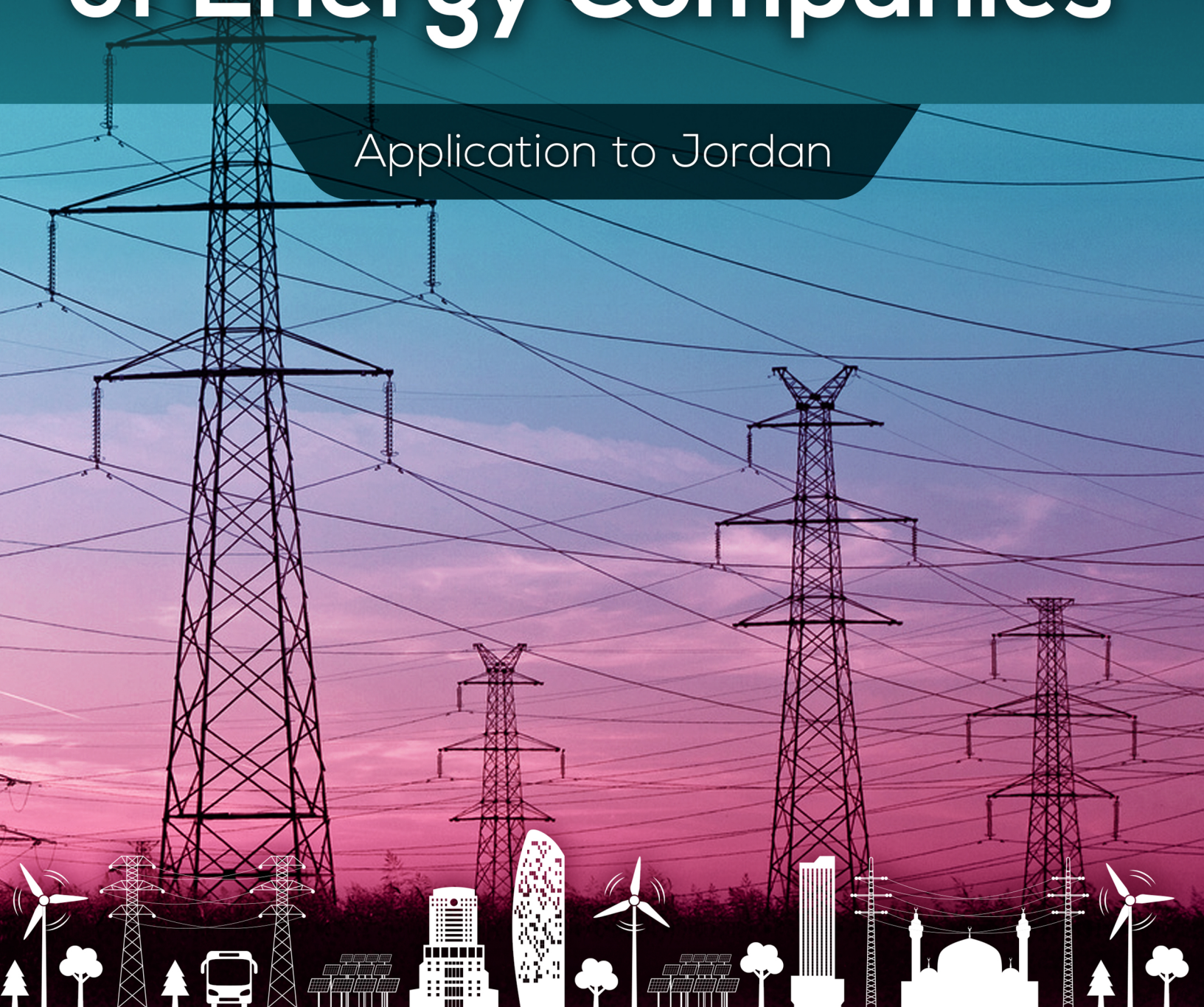


Transformation Processes of Energy Companies

Application to Jordan



Wuppertal

March 2020

Study on behalf of the Friedrich-Ebert Stiftung

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Climate and Energy Project
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**Wuppertal
Institut**

Written by:

Maike Venjakob
Oliver Wagner
Thomas Adisorn

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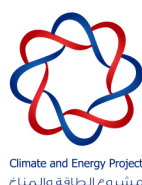
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List of Abbreviations:

Acronym	Description
DSM	Demand Side Management
EES	Energy efficiency service
ERC	Electricity Sector Regulation Commission
ESCO	Energy service company
IEA	International Energy Agency
IPP	Independent Power Producers
MEMR	Ministry of Energy and Mineral Resources
MLP	Multi-level perspective
NECP	National Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NEPCO	National Electric Power Company
RCREEE	Regional Center for Renewable Energy and Efficiency
REEL	Renewable Energy and Energy Efficiency Law

3.0: INTRODUCTION

The energy system of Jordan is facing a rise in energy demand while having quite limited own conventional energy resources. Especially regarding the high import dependency, Jordan is starting to change its energy system and puts a higher focus on renewable energy (like wind and solar) and energy efficiency. The national Energy Strategy for the period of 2007 to 2020 and the updated one for 2015 to 2025 aims at diversifying the energy resources and plans to increase the electricity generation capacity from renewable energy sources up to 1.8 GW by 2020, setting a target of 10% primary energy demand from renewable energy by 2020. Jordan has also set up a National Energy Efficiency Action Plan (NEEAP) and plans to achieve a 20% reduction of primary energy consumption by 2020 compared to 2007.

The Jordanian electricity market is dominated by a few big companies, especially by the state-owned National Electric Power Company (NEPCO). NEPCO owns the nationwide transmission network. The electricity sector includes 5 private producers (Central Electricity Generating Company – CEGCO, Samra Electric Power Generation Company – SEPGCO, Korea Electric Power Corporation – KEPCO, AES Jordan, ACWA Power) and 3 private distribution system operators (Jordanian Electric Power Company – JEPCO, Electricity Distribution Company – EDCO, Irbid District Electricity Company – IDECO). NEPCO purchases the electricity produced as single buyer and sells it on to the operators of the distribution networks. In this system, NEPCO bears the full financial risk. The electricity price for end consumers is subsidized based on the profits or losses of the electricity sector as a whole. Due to losses occurred by NEPCO in the years 2011/2012 there was a reduction in subsidies. Furthermore, detailed tariff structures depending on consumption have been introduced. One of the current challenges for NEPCO is the fact that more and more customers start producing their own electricity based on photovoltaic systems. As a consequence of the increasing share of renewable energies in the system and more self-supplying consumers of electricity for the company and its assets (transmission grid) it becomes evident that there is a need for an efficient and fast transformation of the transmission grid.

In this short paper we first discuss the transformation of energy companies in Germany, then highlight the possibilities of energy efficiency services and examine the transferability to Jordan, based on the results of a questionnaire among Jordan energy experts. Due to the low level of research knowledge in the specific field, this is an exploratory research approach.



At first glance, the situation of the energy market and the energy market framework conditions in Jordan and Germany appear to be completely different. Nevertheless, there are still some similarities and starting points for measures based on the German model can be identified:

- At the beginning of energy transition, both countries have been dominated by one or a few number of (state-owned) energy companies. During the energy transition, such traditional energy companies are often losing revenues due to the changing markets.
- One aim of the Jordan Energy Strategy is to increase the share of local energy in the energy mix. The picture of today's energy market in Germany is characterised by a large number of local energy companies / municipal utilities (so-called Stadtwerke).
- In Germany, the share of renewable energies in primary energy demand in 2018 was 13.8 %. Jordan is aiming for 10 % by 2020.

To show the most important points in the historical development of the German energy industry, the analysis is based on the Multi-Level Perspective (MLP) of Geels (Geels 2002). This analysis focuses on the relationships, actors and framework conditions of the electricity system. The MLP is a suitable instrument to illustrate the transformation, as it is a tool to emphasize the interactions between different levels. With MLP, the numerous influencing factors as well as the complex interrelations between different actors of the German energy transition can be presented in a structured way (Berlo, Wagner, und Heenen 2017). This method also implies that the transformation towards a sustainable economy is driven by changes in key sectors such as the energy sector (Schneidewind und Scheck 2012).

It is obvious how pressure to change has affected the existing structures in recent decades. The energy sector transformation in Germany is a perfect example of how niche developments can change an entire system. Using a multi-level model, the perspective separates transformative developments into technical niches, regimes, and landscapes. At the lower level, niche innovations take place that have the potential to bring about groundbreaking changes (Geels und Schot 2007). The incumbent system is represented by the socio-technical regime at the second level, which is a network of established, dominant institutions and players, with regulative and normative capabilities to preserve the structures and routines of the conventional system (Geels und Schot 2007). The third level is represented by the socio-technical landscape and contains exogenous factors that are difficult to influence, e.g., climate change and urban-ization. However, rules and institutions, such as international law and the United Nations, also induce developments and exert pressure on the existing system (Schneidewind und Scheck 2012).

The MLP is a multi-level model to divide transformative developments into socio-technical landscapes, regimes, and niche innovations, and enhances the interdependent relationships between these levels. The so-called niche actors anticipate these development trends and use the windows of opportunities. They act as "pioneers of change" (Grießhammer und Brohmann 2015).

4.1 Historical Analysis of Energy Market Developments from the Multi-Level Perspective

German energy policy over the last 70 years has ranged from a strong enthusiasm for coal and nuclear energy during the years of the economic miracle of the 1950s to a deep skepticism especially against nuclear since the mid 1970s, when protests against new nuclear power plants began (Renn and Marshall 2016). In the following we describe the reasons for this change and analyse the central change processes.

The following graph shows that with the introduction of the Renewable Energy Sources Act in 2000, electricity generation from renewable energies gradually increased, while electricity generation from the four largest German energy companies, the so-called "Big 4", declined, thus reducing their market share.

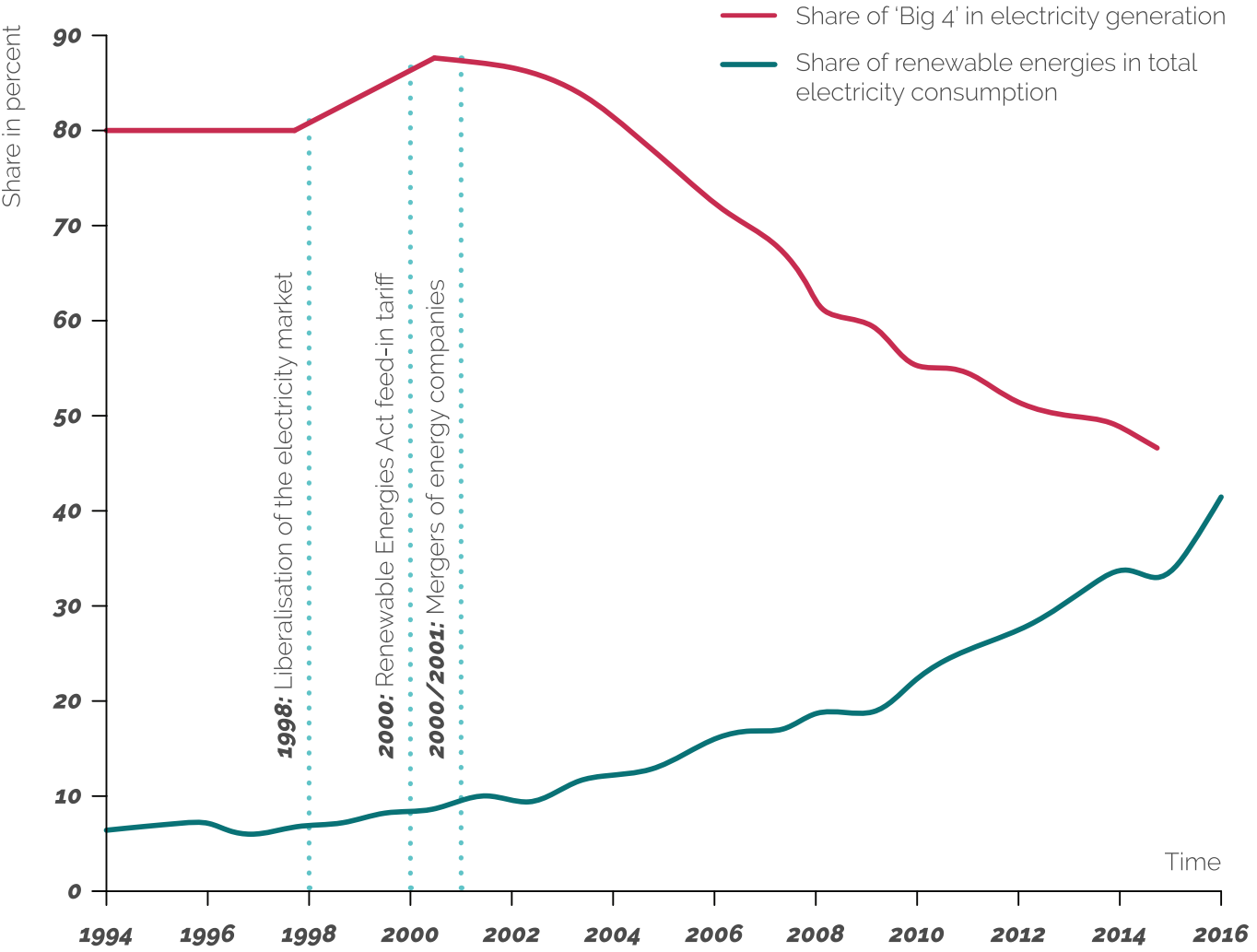


Figure 1: Rising share of electricity generation from renewable energy and declining market share of the "Big 4" since the liberalisation

In terms of the niche innovations relevant to the developments in the energy sector, especially the anti-nuclear movement of the 1970s—which started with political resistance to the planned nuclear power plant in the German village of Wyhl am Kaiserstuhl—needs to be mentioned. A political awareness developed and spread that opposed nuclear power due to its high risks and started the discussion on an alternative energy future. One example of this awareness is the renowned study "The energy transition is possible" of the Freiburg Öko-Institute in 1985 (Hennicke et. al 1985). The authors call for a new energy policy and propose breaking up the monopolistic market power of large energy corporations by means of a nationwide re-municipalization strategy. In addition to the political awareness, two more factors in terms of niche innovations should not be forgotten:

1. Successful electricity grid takeovers of the past—which took place in the small city of Schönau, for example. In Germany, grid possession is regulated by concession contracts between energy company and local authorities. These contracts usually have a term of 20 years, after which the concession is renegotiated. In the case of Schönau, citizens protested massively against a new contract for the local electricity monopolist and in the end the citizens' movement succeeded in obtaining the concession. Today, "Elektrizitätswerke Schönau" is a cooperative enterprise and supplies electricity from renewable sources throughout Germany.

2. The foundation of civil energy associations / cooperatives. The establishment of these institutions is closely linked to the legal framework in Germany. The promotion of the expansion of renewable energies in particular has led to the decentralization of the German energy system in recent years. The introduction of the Renewable Energy Act (EEG) has regulated priority feed-in and fixed remuneration for renewable energy. The law created the conditions for predictable payment flows. For citizens who participate financially, non-financial motives often play a very important role besides a low-risk investment. This legal basis also led to associations of citizens (often as cooperatives) who jointly invest in wind turbines and large photovoltaic systems. About 1,700 such companies were newly established in Germany (Kahla u. a. 2017). Against this background one can rightly say that citizen energy companies / cooperatives have a large share in the production of renewable energy in Germany and have become an international role model (Holstenkamp und Kahla 2016; Kahla 2018).

The third level of the MLP—namely the socio-technical landscape—is characterized by occurrences like the oil price crisis in the 1970s, the proceeding climate change, natural catastrophes, a strong anti-nuclear movement since the mid 1970s and the nuclear accidents in Chernobyl (1986) and Fukushima (2011). Further processes belonging to the third level of MLP are the expiration of many grid concessions for electricity and gas, between 2010 and 2016, and the energy program of the German government.

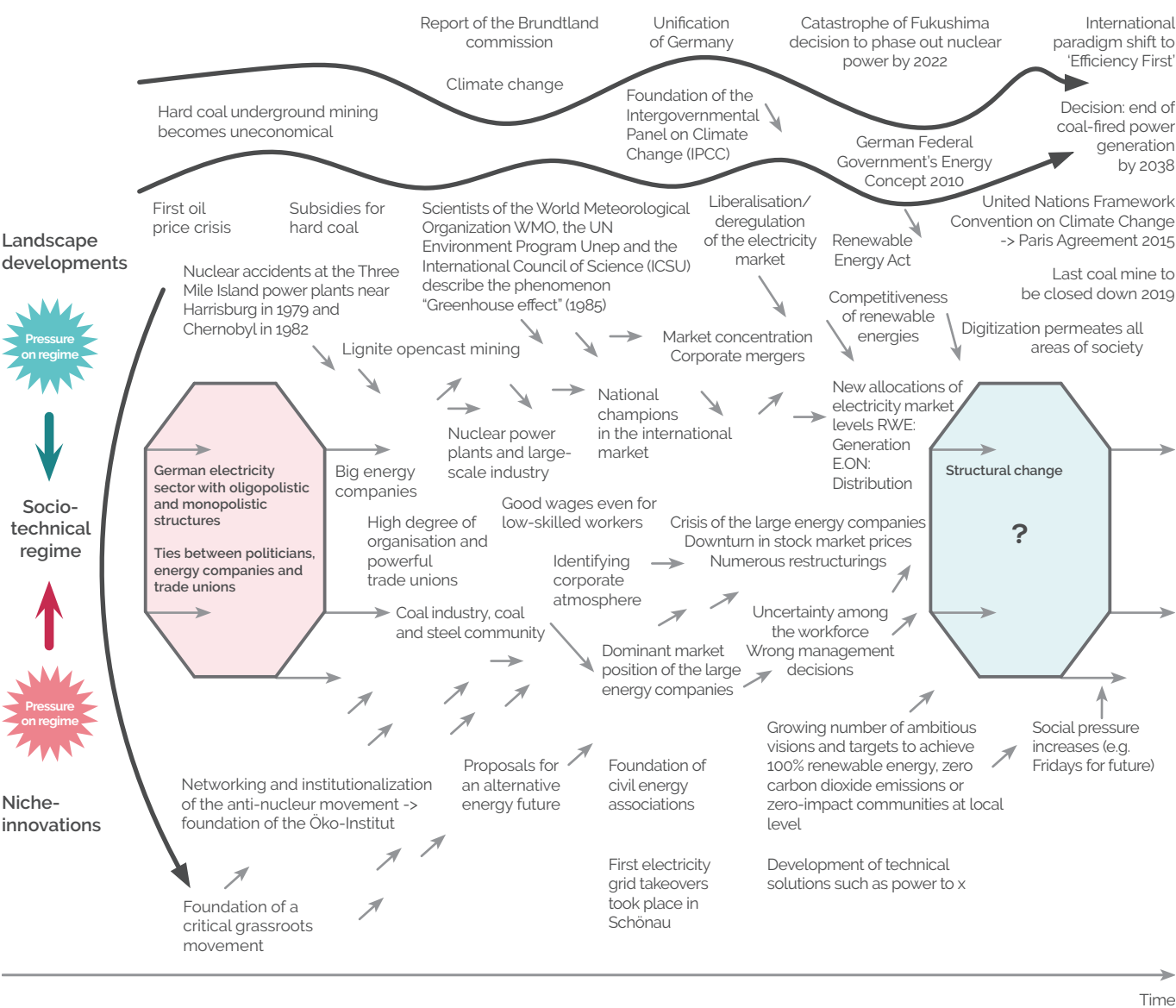


Figure 2: Structural change in the energy sector and the local distribution grid for electricity and gas, presented through the multi-level perspective according to Geels. Depiction based on Geels (2002)

4.2 Steps of How to Phase-out Fossil Fuel

The German energy transition is linked to the European framework. End of 2019 the European Green Deal was adopted. The main goal is to be the first continent to become climate neutral by 2050. To this end, an ambitious package of measures is being put in place, ranging from drastic reductions in emissions to investments in cutting-edge research and innovation and the preservation of the environment. Especially investments in green technologies and sustainable solutions should trigger Europe's new growth strategy, creating new opportunities for diverse businesses. At the same time, it is intended to pave the way for greater social justice.

To become climate-neutral, an intelligent infrastructure is required. The Green Deal calls for increased cross-border and regional cooperation "to reap the benefits of the transition to clean energy at affordable prices" (European Commission, 2019). Currently, EU policy on "Trans-European Networks for Energy (TEN-E)" focuses on linking the energy infrastructure of EU member states. This policy includes, for example, connecting regions currently isolated from the European energy markets, strengthening existing cross-border connections and supporting the integration of renewable energies.

With the energy transition, Germany like most of the other European countries is gradually converting its energy supply from fossil and nuclear energy sources to renewable energy sources. The energy policy triangle of supply security, affordability and environmental compatibility is the central guideline of the German energy policy and core of the German Energy Industry Act. Germany's national targets are in line with the targets adopted at EU level. While the EU as a whole is well on the way to achieving its energy and climate targets for 2020, Germany will miss them.

The following table provides an overview of Germany's climate protection objectives and shows the status achieved in 2017.

Targets of German Politics by Year					
Year	2017	2020	2030	2040	2050
Greenhouse Gas Emissions					
Greenhouse gas emissions (compared to 1990)	-27.5%	Min. -40%	Min. -55%	Min. -70%	Largely greenhouse gas neutral (-80% to -95%)
Renewable Energies					
Share of gross final energy consumption	15.9%	18%	30%	45%	60%
Share of gross electricity consumption	36%	Min. 35%	Min. 50% (EEG 2017: 40% to 45% in 2025)	Min. 65% (EEG 2017: 55% to 60% in 2035)	Min. 80%
Share of heat consumption	13.4%	14%			
Efficiency and Consumption					
Primary energy consumption (compared to 2008)	-5.5%	-20%			-50%
Final energy productivity (2008-2050)	1.0% per year (2008 - 2017)	2.1% per year (2008 - 2050)			
Gross electricity consumption (compared to 2008)	-3.3%	-10%			-25%
Primary energy demand for buildings (compared to 2008)	-18.8%				-80%
Heat demand for buildings (compared to 2008)	-6.9%	-20%			
Final energy consumption in transport (compared to 2005)	6.5%	-10%			-40%

Table 1: Quantitative targets and status quo (2017) of Germany's energy transition (Source: BMWi 2019b)

For example, the German energy concept from 2010 has set the target of reducing primary energy consumption by 20% by 2020 compared to 2008. In 2018 only 6% was achieved, which makes it almost impossible to reach the target by 2020. Therefore, Germany will not meet its 2020 targets, but is sticking to its 2030 targets.

In the summer of 2018, the Federal Government set up the Commission "Growth, Structural Change and Employment", with actors from various economic and social groups. This integration of different stakeholders from trade unions, industrial associations, environmental associations, Policy makers, scientists etc. was the prerequisite for the success and the acceptance of the Commission's results. The commission developed its suggestions out of a bottom-up shaped process that took into account the concerns and requests of its various representatives.

The task of this commission was to develop a socially acceptable proposal on how Germany can abandon the generation of electricity from coal. For this reason, the Commission was often referred to as the "Commission on Coal". In concrete, the tasks of the Commission included for example:

- to create a perspective for new job opportunities in the regions that are strongly affected by ending coal-fired power generation, and
- to develop a mix of instruments that combine economic development, structural change, social compatibility, social cohesion, climate protection and also enhancing structural change towards future-oriented and sustainable energy-regions.

The Commission presented its final report on 31 January 2019. In it, the Commission submits proposals aimed, among other things, at securing the sectorial target for the energy sector for the year 2030 set out in the Climate Protection Plan 2050. These include a gradual reduction and an end to coal-fired power generation by 2038 at the latest (BMW i 2019a). The Commission's report resulted in the Federal Climate Change Act, which came into force on 17th December 2019.

There will be changes, particularly in the transport sector and regarding a closer link of the energy and the industry sectors (i.e. sector coupling, especially electricity, heating, cooling, transport, industry). The expected increase in renewable energies for electricity generation will be associated with significant changes in the energy market and the associated infrastructure. This will have far-reaching consequences for existing companies in the energy industry. They have to:

- Withdraw their existing conventional power generation plants from the market,
- Invest in the expansion of renewable energies,
- Adapt their infrastructures (in particular the electricity grid) to the challenges and develop new services contributing to a secure energy supply (demand side management).

This is also shown in figure 3 on the following page, providing an overview of the phases of energy transition adapted to the MENA region. German is currently in phase II of the energy transition, where the main focus lies on renewables integration and increasing flexibility options. According to Holtz et. al (2018), Jordan is in phase I, meaning that a take-off of renewable energy has already taken place. Steps towards system integration are already being taken, therefore Jordan is beginning to reach some niche levels before the entrance into phase II.

In June 2018, the German Federal Network Agency (BNetzA) approved the scenario framework for the transmission grid development plan 2019-2030, taking into account the range of probable developments within the framework of the federal government's energy policy goals up to 2030. The scenarios take into account the coalition agreement's target of a 65% share of renewable energies in the electricity sector and the requirements of the 2050 climate protection plan. This is achieved in the individual scenarios by a varied mix of renewables for the year 2030 (wind at sea: 17 to 20 GW, wind on land: 74 to 86 GW, photovoltaics 73 to 105 GW). This means that the climate target for 2030 will also be met in all scenarios of the German government and partly coincide with the recommendations of the Commission "Growth, Structural Change and Employment". This ensures that power grid planning also takes coal phase-out into account. In order to take into account a range of probable developments, the scenarios make assumptions about sector coupling of varying strength (e.g. number of electric cars and heat pumps, power-to-gas) and thus also different electricity consumption.



Figure 3: Transition Phase Model, adapted to the MENA Region. Source: Holtz et. al, 2018

Due to the German energy transition the national energy companies cannot continue business as usual. They have to rethink their traditional business models and create new, sustainable strategies to service on the market and to generate profit in the future. There are several opportunities for companies to discover new areas and to develop niche markets. According to a survey published by Statista in 2019 (Statista DMO 2019), several energy providers were asked for future business models and opportunities for cooperation with third parties. The results show that renting of solar modules, energy services and contracting models for heating systems got the most votes. The next table shows the results of the survey.

1	Renting of solar modules	39.8%
2	Energy services such as energy advice	39.8%
3	Contracting models for heating systems / technologies	37.3%
4	Providing charging station infrastructure	28.9%
5	Energy advice during retrofit	28.9%
6	Decentralised neighbourhood supply concepts	27.7%
7	Offers for the digital control of electrical appliances (Smart Home)	19.3%
8	Contracting models for building technologies	14.5%
9	Carsharing	13.3%
10	Smart metering and display of energy consumption and costs	13.3%
11	Others	9.6%
12	No answer	3.6%

Table 2: Possible new cooperation of energy providers with third parties: Survey results

As regards the charging infrastructure for e-mobility, a survey done by PWC (2018) found that energy companies do not only maintain charging stations (88%), which is obviously closest to their original business model; some even manufacture such charging infrastructure. The study also finds that a majority of public charging stations in Germany and Austria are operated by energy companies. Apart from that, larger energy companies are more likely to invest in this new business activity, which is most like due to their better ability to finance larger investments and staff capacities. While this business area appears to be a promising market, also because of government targets and financial incentives for BEV purchases, other players emerge on the horizon. For instance, the emergence of Elli, a subsidiary of Volkswagen, shows that financially sound competitors from other sectors are also seeking to provide charging services for BEVs.

In this chapter we will mainly deal with energy efficiency, being generally an important pillar of the energy transition alongside the expansion of renewables: „Making efficient use of electricity, heat and fuel saves money, boosts energy security and combats climate change“ (Federal Ministry for Economic Affairs and Energy 2015). In line with this premise, Jordan aims to reduce its primary energy consumption by 20% by 2020. The International Energy Agency (IEA) considers that, by 2035, investments in energy efficiency need to represent nearly half of all the global energy investments required to stay under the two degree limit.¹

Though energy efficiency is one of the main pillars of energy transition, it often plays a minor role compared to the generation of (renewable) energy, as it doesn't hold out the prospect of big profits for companies but lower sales of electricity. Therefore, the European Commission has obliged its Member States to implement appropriate measures to increase energy efficiency. There are different ways to meet this obligation: setting up a white certificates market or implement appropriate national energy efficiency programmes.

White certificates are schemes in which market participants, in particular energy suppliers and network operators, are obliged to achieve a certain savings target within a certain period of time and to implement energy efficiency measures among consumers. For example, all electricity suppliers in a country are obliged to reduce the energy consumption of their customers by 5% during one year. This can be achieved by supplying energy efficiency services to the customers. For the energy savings achieved, the market participant receives corresponding certificates, which can either be used to meet own obligation or sold to other market participants. If an obligated energy supplier or distributor has collected too little or no certificates, it will be charged a penalty fee. White certificate markets are in place for example in Italy, France, Denmark, the UK or the USA.

Germany has opted for another way to increase energy efficiency, building on the principle of supplying information, providing support, and demanding action. The first step is to provide information in order to know where individual energy efficiency potentials are given. The second step lies in a targeted and innovative support of energy efficiency investments, especially for energy efficiency measures in buildings. And third, large companies are obliged to carry out energy audits, and energy efficiency standards for buildings are implemented (Federal Ministry for Economic Affairs and Energy 2014).

Over the period 1990-2016, the energy efficiency of end-use sectors improved by 30% in the EU-28 countries. This was mainly driven by improvements in industry (1.8% per year) and households (1.6% per year). Half of the efficiency gains achieved through technological innovations in the household sector were offset by the increasing number of electrical appliances and by larger households, so that the overall energy efficiency improvement could have been much higher.²

Energy efficiency services (EES) are particularly interesting for obligated energy companies in a market for white certificates, but also for energy companies in other countries. EES involve energy companies in energy efficiency measures and enables them to benefit from them. Energy efficiency services can offer cost-effective energy solutions to private companies, public administrations and households. The increase in end-use energy efficiency induced by such services is an important response to the demands of the energy market of the future. The potential for profitable EES in Europe is high as the market for such services in several countries is still at an early stage or not yet well developed (ChangeBest, 2012; Deloitte 2016; Szomolányiová & Keegan 2018).

¹ CarbonBrief (2014): <http://www.carbonbrief.org/iea-the-marginal-cost-of-two-degrees>

² <https://www.eea.europa.eu/data-and-maps/indicators/progress-on-energy-efficiency-in-europe-3/assessment>

From 2009 to 2012 the Wuppertal Institut has coordinated the EU-project „ChangeBest“ that aimed to support energy companies, energy service companies (ESCOs) and other interested market actors in developing and introducing new energy efficiency services for private households and business clients. Concrete services have been developed and implemented by energy companies in Austria, Bulgaria, the Czech Republic, Denmark, France, Germany, Greece, Italy, Latvia, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden. Though the project has finished already some years ago, the topic and contents is still up to date.

The ChangeBest project concluded that there is a large potential for profitable EES by various market actors in Europe. However, many barriers hindered – and to some extent still hinder today – the implementation of new services (Szomolányiová & Keegan 2018). Barriers particularly include the legal framework. However, with a thorough planning of services, chances for successful implementation are given, as many good practices can show. The ChangeBest project has also shown, that information exchange, advice and learning from good practice can particularly help smaller or new EES providers to improve their market performance.

The motivation for developing and offering energy efficiency services is manifold and can also be interesting business cases for energy companies:

- Improvement of public image (since energy efficiency and climate change have a positive connotation);
- Increasing the loyalty of the customer and thus improving the position of a core product (the motivation of small local energy companies would fit into this category);
- Generating additional income.

In those cases, where the EES cannot be „cross-subsidised“ by other businesses of the company, the service to be offered has to be economically viable. This means, that the costs of the action have to be covered by the energy savings achieved. Next to other products, the ChangeBest project has developed a concrete guideline on how to develop profitable energy efficiency service business cases. In the following we will show the major steps.

In order to be successful, EES should be:

- Solution-oriented
- Customer-oriented, and should
- Create additional value.

The first essential element of an EES is to provide solutions for the customer's needs. Solutions often address specific technologies or technology systems of the customer, e.g:

- Building structure
- Heating system
- Ventilation & cooling
- Lighting system
- Electric appliances
- Motors, pumps

The second element of an EES is the target group that the service is intended to reach. The target groups represent different types of energy consumers, which are usually categorised as follows:

- Private households, single family house owners, flat owners, or building own-ers/landlords
- Commerce & services (can be disaggregated once again into private and public services resp. service buildings: office buildings, hospitals, schools, shopping centres)
- Industry, energy-intensive branches, SMEs
- Transport

These two elements (target group and technology system) are closely interlinked, as specific target groups are characterised by the application of typical technology systems.

The third element for designing an EES is the position on the „value chain“ of the energy improvement. Each energy efficiency improvement action consists of a preparatory phase (information, advice, planning), the core phase of implementation and an operation and monitoring phase. Each of these phases represents a certain „value“ in terms of energy savings achieved, respectively of providing a certain service to the customer.

To sum it up, in the beginning, a service provider has to be clear about the motivation as different goals are thinkable. Then, the three constitutive elements for an EES should be taken into account (see in more detail above):

- 1. The new service to be offered should match customer needs. Solutions often address certain technologies like building structure, heating/cooling systems, lighting system, etc.
- 2. It should be clear, which target group is going to be addressed. I.e. private households, building owners, commerce & services, hospitals, schools, industry, etc.
- 3. The service should be designed for a specific position in the „value chain“ of an energy efficiency improvement. Such value chains include a preparatory phase (information, advice, planning), the core phase of implementation (physical implementation), operation, maintenance and monitoring.

The following figure shows exemplarily how the design of an EES can be visualized by putting together the three constitutive elements of the offer that fits best to the company.

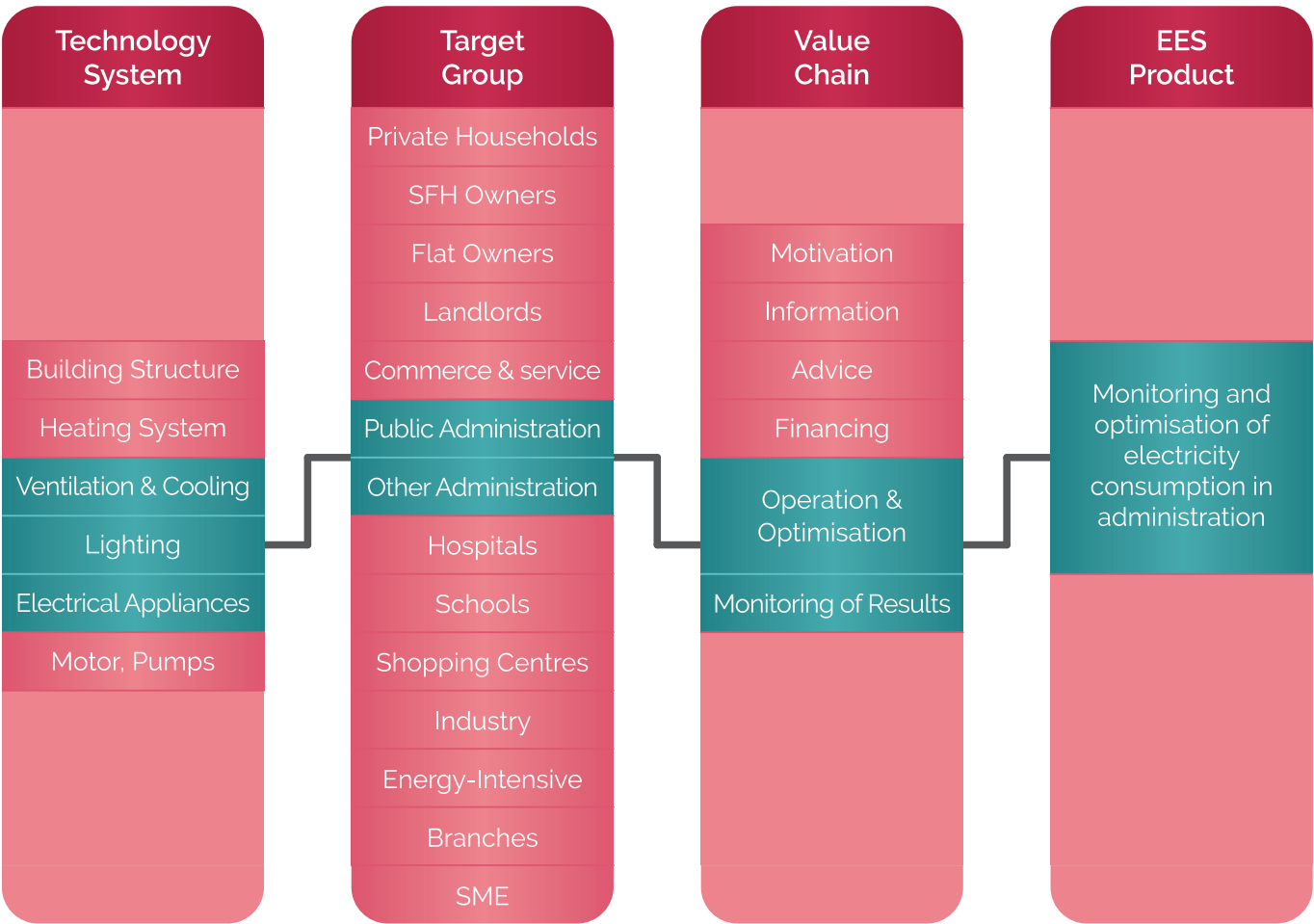


Figure 4: Design of EES by putting together constitutive elements

During the ChangeBest project, 48 new service offers were created, far more than planned. The amount of energy saved is a key success criterion for any energy efficiency service. However, there are other aspects to consider when evaluating market success. For example, the degree of innovation, the intelligent combination of services and technological implementation can represent an important added value for customers. Above all, integrated energy efficiency services, i.e. the combination of energy efficiency measures with renewable energies, are often easier to sell.

Case studies / examples:

Developing competitive advantages for a potential EES related to the refurbishment of buildings, e.g. of single family houses

Starting from the observation that the buildings sector and for example the single family houses market offers a high potential for energy efficiency improvements in general a standardized refurbishment package could be prepared by an EES provider. Such a package could include a building analysis, the planning of appropriate energy efficiency measures and the implementation as an integrated service thus relieving the home owner from a lot of preparation, co-ordination and controlling work in which the home owner usually has little practice.

This general idea for an energy efficiency service needs to be cross-checked with current national practice:

The refurbishment of a building, e.g. a single family house, may be supervised by an architect or a master builder. This service is, at least in Germany, usually perceived as good quality but expensive. The competitive advantage of an energy efficiency service refurbishment package could be a differentiation through a focus on certain technical measures, e.g. thermal refurbishment. Such a focus could lead to a competitive price due to standardisation of the technical measure.

For the other share of potential customers who refurbish their homes in a do-it-yourself approach, the EES refurbishment package could focus on a better quality offered at an attractive price.

Another example of a service developed during the ChangeBest project is the following:

Energy Efficiency for Refrigeration Systems in Portugal

Of particular interest for a country like Jordan are the EES developed in Southern Europe, as the climatic conditions are comparable and many EES from the northern counties are aimed at reducing heat demand. This EES developed in Portugal includes the installation of a mimicking device – the eCube – in refrigerators and freezers and targets customers like food and beverage industries, restaurants, supermarkets, catering, food retail shops, etc. The installation is quick and can be carried out during operation of the refrigerators. The existing sensor of the refrigerator/freezer is inserted into the eCube box. This device allows the sensor to measure the actual food temperature and not the fluctuating air temperature in the systems. In this way, the frequency of the refrigeration circuits is reduced while the food temperature is maintained as required. This increases the life of the refrigeration system and reduces energy consumption.

The Portuguese company EnerEfficiency offered this service and was responsible for the monitoring of the refrigeration system. Usually, EnerEfficiency installs energy power meters in the switch board of the refrigeration system one week before the installation of the eCube. In this way the ex-ante energy consumption is monitored. The power meters remain there for another week, after the installation of the eCubes. In some cases, the monitoring period is extended in order to avoid the interference with batch cycle processes. Online monitoring is also possible. No additional equipment is necessary.

The savings achieved are usually high but there is an unpredictable factor related to the maintenance status of the refrigeration network that can have a negative influence in the savings achieved. For

example, refrigeration gas leaks, which were not perceptible before the eCube was installed, affects the results. In addition, during the monitoring period, the customer should not connect additional loads in the same circuit where the eCubes have been installed.

This product has been promoted in a Demand Side Management (DSM) campaign, which was a driver for the success of the implementation of the service. The benefit for the customer includes large immediate energy savings combined with a relatively low investment.

Given the high dependence on energy imports – in 2018, 92% of Jordan's energy was imported (MEMR 2018) – and the geographical situation in a crisis region, energy security is one of the main challenges for the country. To reach a higher energy independence, the share of nationally produced renewable energy, as well as the level of energy efficiency needs to increase.

The conditions for renewable energies, especially in form of PV and wind are favourable in Jordan, due to high solar radiance and appropriate wind speeds. As Jordan is located in the earth's solar belt, it has the potential to generate at least 1,000 GWh of solar power per year (Hayek, n.d.). Together with energy from wind, there are estimates that this could deliver up to 50 times more than the country's expected electricity demand by 2050 (Baniyounes, 2017). The target share of renewable energy in the final energy mix is 10% in 2020. Though progress has been made, especially regarding large renewable energy systems, the current share as well as the targets are too low, especially when having in mind the good conditions for renewable energy.

Indispensable for a successful energy transition is also an increase in energy efficiency. Energy efficiency can be seen as a prerequisite for an energy system based on renewable energy, as otherwise the power demand would be much higher and probably would exceed the country's renewable energy potential.

6.1 Energy Transition Phase in Jordan

A study by Holtz et. al (2018) shows, that Jordan is currently in the first stage of energy transition. For reaching the second phase (system integration), efforts especially in the fields of new business models and the exploration of flexibility options have to be taken.

Technical innovations for the generation and provision of renewable energies, i.e. above all the maximum use of the given flexibility options, must go hand in hand with an energy transition by new actors who challenge the established incumbents and inflexible market structures with new and different organisational forms. The conditions for new actors have improved in Jordan in recent years. The country has already taken several steps towards unbundling and reforming the electricity sector. Generation and distribution were privatised and the Electricity Sector Regulation Commission (ERC) was established in 2001. Several IPP (Independent Power Producers) are active in the market and with the Renewable Energy and Energy Efficiency Law (REEL), the Jordanian government is promoting private investment in the field of renewable energy and grid infrastructure. However, since 2019 the investment has slowed down, as the Ministry of Energy decided to freeze all projects bigger than 1MW. Nevertheless, local energy companies, in particular, could play an important role in Jordan, as they not only provide energy and energy efficiency services, but also bring a number of other advantages for the local population. A scoping study carried out in 2013 by Wuppertal Institut showed that the following ten reasons in particular play an important role by setting up local energy companies in Germany (Wagner, Berlo 2015):

1. Achieving environmental objectives and organisation of the local energy transition
2. Higher local added value
3. Harnessing tax regulations for improving municipal services
4. Improving the income situation of the city
5. Democratisation of supply and stronger orientation towards the common good (public value)
6. Creating and protecting good jobs
7. Acting in social social responsibility in energy supply
8. Expansion of eco-efficient energy services
9. Harnessing customer relations and public image
10. Materialising synergies with other sectors

Such decentralisation of energy supply plus the offering of local energy efficiency services is usually combined with another process: The promotion of direct democracy and the influence of citizens on energy and climate policy make decentralised actors particularly important in the context of energy transition (Wagner et. al under review). The development of the German energy industry and the German energy system transformation shows that it is possible to achieve higher shares of renewable energies by diversifying the energy market. Though the "big four" energy companies in Germany (Eon, RWE, EnBW and Vattenfall) still have the biggest share in electricity generation, the pressure for using more renewable energy originated in small local energy companies. Especially the widespread of municipal utilities, so called "Stadtwerke" has led to a mainstreaming of renewable energy. Based on decentralised, local renewable energy production and (financial) participation models for the citizens, an identification with municipal utilities and renewable energy production could be reached. Such a sense of local ownership is a prerequisite for broad social acceptance for renewable energies.

In order to be able to implement these approaches, however, appropriate framework conditions, both legal and political, are needed.

6.2 Survey in Jordan

Based on the theories regarding a transferability of German aspects of the energy transition and energy efficiency services to Jordan, some experts of the Jordan Engineers Association have completed a questionnaire (see Annex). Their assessment regarding the general energy transition in Jordan is, that from a technical point of view, the share of renewable energy could be increased. However, due to several obstacles, especially at the political level, the experts do not believe that there will be a strong short-term increase in renewable energies. This is also shown by the unanimous opinion, that the renewable energy target for 2020 will be missed. This target demands a 10% share of renewable energy in the energy mix; until 2018, 7.3% could be reached. Top priority is given to the exploitation of flexibility options, i.e. increased use of smart grids for reducing grid losses. Additionally, the experts do not expect, that Jordan will become an exporter of renewable energy to Europe, as envisaged by several politicians and scientists.

On the other hand, the experts do agree, that the Jordan energy market will have to change, for example by the abolition of subsidised electricity prices and that an expansion of renewable energy will offer job opportunities for the young people of the country. This would indeed be necessary since the average age in Jordan is just under 23 years (for comparison in Germany it is 47 years) and the unemployment rate is high. In this regard the experts agree, that a market for energy efficiency services in Jordan would be a promising start. They believe that such services would support customers to further increase energy efficiency and also think that there are companies that would be willing to actively support such a market for energy efficiency services. These services are particularly needed for the refurbishment of buildings, the implementation of energy management programmes, the establishment of water and efficiency programmes and the dissemination of smart devices.

Due to existing differences in resource availability, energy market structure, political conditions, etc. measures initiated on the German and European energy market cannot be transferred one-to-one to the Jordan energy market. The decisive factor for the German energy transition was above all political willingness and the broad support of the population. This has grown over many years and Germany had and needed a lot of time for this. In view of the current urgent need to combat climate change, many other countries have less time to make the necessary changes. Jordan seems to be on the right track, as the predominantly young population has recognised the need for a secure and efficient energy supply as a condition for a good future (FES 2018). Moreover, Jordan has good natural conditions for a stronger expansion of wind and solar energy.

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Questionnaire | November 2019

Short project description

In the project TrafoJordan the researchers will provide an overview of the energy sector transformation in Germany and will also include examples from other European countries for specific aspects where useful. In a second step they will provide a guideline for developing successful energy services and energy efficiency services. Even though the framework conditions in energy markets vary and a complete transfer of successful elements is not possible, some basic elements can be identified that have to be taken in mind for shaping a promising transformation process. Last but not least, the project team will discuss the transferability to Jordan. In order to achieve the highest value possible out of it, some short interviews will be carried out.

National Energy Transition

The momentum for a newly designed energy market in Jordan is there. What do you think would possibly happen in the coming 5-10 years:

- Can the country's dependence on imports be significantly reduced by expanding renewables?
- Renewable energy in primary energy will reach the 10% target in 2020
- Energy efficiency will further increase
- Complete unbundling of the Jordan electricity market
- Change of the single-buyer market
- Abolition of the subsidised electricity prices
- Would a strategy for the expansion of renewable energies also offer career prospects to the many young people in the country?
- Are there obstacles that stand in the way of a strategy of further renewable energy expansion?

Corporate Strategies for the Energy Market

- In the long-term, do you see Jordan companies as exporters of renewable energies to Europe?
 - What is Jordan's position on PtX? Are there already any considerations? Is there interest in stronger cooperation with European companies?
 - What is Jordan's strategy in order to enhance and update the existing grid? E.g. are there plans to use smart grid technologies?
-

- In your opinion, what should be done to cushion a possible end to subsidised electricity prices? E.g. would it be sufficient to increase energy efficiency on the demand side as well as the efficiency of the grid in order to reduce energy consumption and therefore reach lower prices?

New Energy Services

Increased energy efficiency on the demand side would amongst others help to stabilise the grid as less power needs to be feed in.

- Would it be helpful for the Jordan energy market if new energy (efficiency) services would be supplied to end consumers?
- Do you see any companies that would actively support the development of a market for energy (efficiency) services and would offer such services?
- What kind of energy (efficiency) services would be most valuable for the Jordan energy market? E.g. installation of smart meters, dynamic pricing, smart home appliances, etc.

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